PATENT SPECIFICATION

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COMPLETE SPECIFICATION

DRAWINGS ATTACHED

Improvements in and relating to Dehydrators

We, VAN PRODUCTS COMPANY, a Corporation organised and existing under the laws of the State of Pennsylvania, United States of America, of Erie, Pennsylvania, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to dehydrators and, more particularly, to devices and processes for removing moisture from gases and, especially, air.

Many types and designs of dehydrators have been proposed and used for removing moisture from air and other gases and liquids; however, many of these devices have been intricate and expensive to operate and have not given completely satisfactory results.

The present invention relates to the use of a material for removing moisture, for instance, water, from gases by the use of a hygroscopic material in pellet form. The material can be varied from slightly acid pH to acid or alkaline but, in use, an attempt should be made to maintain a pH close to neutrality to prevent corrosion. This material may be disposed in a container connected in a compressed air system. The dehydrator can also be used as a moisture eliminator to remove moisture from tank vents to prevent the entrance of atmospheric entrained moisture when the tank breathes or is emptied or filled. Oil, alcohol, and gasoline storage tanks are examples of these applications.

It has been discovered that when a suitable soluble material in porous pellets of suitable size is impregnated with a minor quantity of calcium chloride, and moist air is passed through a bed of this material, a part of the moisture content will be attracted to the calcium chloride. The porous soluble material is a structure made up of soluble crystals adhering to each other, thereby forming a porous support. A more hygroscopic material is added to the porous soluble support by impregnating the support between the crystals with the more hygroscopic material filling the voids between the crystals of the porous support. When impregnated pellets made of the porous soluble material are put in an air drier in the path of flow of moist dry air, the hygroscopic material attracts moisture from the air and goes into solution with this moisture.

The basic idea of this compound desiccant is to provide a primary soluble material in porous pellet or lump form to which is added a soluble and more hygroscopic material and preferably an anticorrosion material, thus forming a progressive dissolving action as air passes up through the bed of desiccant.

The pellet size is important since this governs the area of the outside of the pellets exposed to the moist air and this has a considerable effect on the bed of pellets caking and the tendency of air to form large channels through the bed. The minimum size of pellets is most important since too small pellets will resist the flow of air. It has been discovered that pellets of one sixty-fourth inch to one inch in maximum dimension are satisfactory with most desirable dimensions being between one-half inch and one inch. Pellets in this range of sizes give optimum air flow, yet expose an ample amount of pellet surface to the air stream to give practical dehydration in industrial applications.

The invention in its broad aspect contemplates the use of a desiccant made up of porous pellets made of a water soluble material impregnated with a soluble and

[Price 4s. 6d.]

more hygroscopic material. This desiccant is suitable to be used in the form of a bed in a container wherein moist air may be passed up through the desiccant bed and moisture from the air will be attracted to the pellets and will dissolve them whereby the moisture will be removed from the air. The basic pellet material is made of a lower hygroscopicity soluble substance as the integral porous core portion and the hygroscopic material which is added as a minor portion is a higher hygroscopicity substance. The higher hygroscopicity substance may comprise between three and ten per-cent by weight of the pellets and the lower hygroscopicity substance may comprise ninety to ninety-seven per-cent by weight.

It is, accordingly, an object of the present invention to provide a material and apparatus for its use which are simple, economical. and efficient.

Another object of the invention is to provide an improved drying material and apparatus.

A further object of the invention is to provide an improved material for air driers.

According to the invention, a dissolvable granular porous pellet comprises a major portion of a low hygroscopicity soluble substance as the integral porous core portion thereof, and a minor portion of a soluble higher hygroscopicity substance impregnated on at least the surface portions of said porous core portion.

According to a further feature of the invention, the higher hygroscopic substance of the above-mentioned dissolvable porous pellet contains a minor quantity of a material having a rust inhibiting property.

According to a further feature of the invention, a method of manufacturing a dissolvable integral granular desiccant porous pellet consisting of a porous core portion of a low hygroscopicity soluble substance and a minor portion of a higher hygroscopicity substance comprises impregnating said porous core portion with a solution of said higher hygroscopicity substance.

According to a further feature of the invention a method of dehumidifying gas that contains moisture comprises depositing a material in the path of flow of said gas so that said gas passes through said material. said material comprising integral pellets of ninety to ninety-seven per-cent sodium chloride impregnated with three to ten per-cent calcium chloride whereby said moisture from said gas goes into solution with said calcium chloride and sodium chloride, and providing a sump below said material to accumulate a solution of said sodium chloride, calcium chloride, and said moisture.

According to yet a further feature of the invention, a dehumidifier comprises an inlet and an outlet, and means to support a material on the inside of said dehumidifier between said inlet and said outlet whereby a gas passing from said inlet to said outlet will pass through said material, said material consisting of particles of sodium chloride. each of said particles being made up of a porous pellet impregnated with calcium chloride, said sodium chloride being present in an amount from ninety to ninety-seven per-cent by weight and said calcium chloride being present in an amount from three to ten per-cent by weight of the total particle weight.

The invention is illustrated, by way of example, in the accompanying drawing in which:—

Fig. 1 is a longitudinal cross sectional view of a tank according to the invention; and

Fig. 2 is a view similar to Fig. 1 of another embodiment of the invention.

The material used in the present invention may consist of sodium chloride pellets from one sixty-fourth inch to one inch in maximum dimension to which calcium chloride, sodium dichromate, and trisodium phosphate are added in liquid form until the pellets are saturated or mixed therewith and pressed dry. The proportions of the material are as follows:—

sodium chloride	90% to 97%
calcium chloride	3% to 10%
sodium dichromate	.01%
trisodium phosphate	.01%

A specific example of the use of the above formula is:—

sodium chloride	100 pounds
calcium chloride	5 pounds
sodium dichromate	1 ounce
trisodium phosphate	1 ounce

Another specific example is:—

$C_6H_{12}O_6$ (sugar)	90% to 97%
$CaCl_2$	3% to 10%

In the above examples. the materials will be used in pellet form. The pellets may be made by mixing an aqueous solution of, for example, one pound of calcium chloride in one quart of water and mixing this with the sugar or the salt or soluble material pellets. The pellets should be within the size limits set forth above in order not to expose excessive areas to the air and in order to allow sufficient air flow through the bed. The sodium chloride pellets may be heated when the calcium chloride is added in order for the calcium chloride to impregnate the pellets better since a hot solution of calcium chloride is considerably more concentrated than a cold solution. The pellets may be first heated to a temperature below their melting point prior to being saturated with the higher hygroscopic substance. and may be heated up to a temperature of five hundred degrees Fahrenheit. One hundred de-

grees Fahrenheit has been found to be a satisfactory temperature.

It may add to the extent of penetration of the solution of the hygroscopic material into the soluble carrier if the soluble material is first heated to approximately 180°F.

Sodium chloride acts as a soluble carrier in integral pellet form. The calcium chloride carries moisture from the air to the sodium chloride and dissolves it. The trisodium phosphate is an alkaline oil emulsifier which emulsifies any oil which may be entrained in the air stream and causes the resulting liquid to drop into the sump. The sodium dichromate prevents rust of the metal parts of the container and also adds a pleasing color to the pellets.

If more than ten per-cent calcium chloride is used, the mass of sodium chloride and calcium chloride may tend to solidify or cake, thus restricting the free passage of air. If less than one per-cent calcium chloride is used, the calcium chloride will have insufficient effect for attracting moisture to the basic carrier.

Table A set forth below is a proposed list of soluble carriers, Table B is a list of hygroscopic materials which may be mixed therewith, and Table C is a list of substances which may be used therewith as oil emulsifiers. Table D is a list of examples of corrosion inhibiters which may be used with certain materials listed below: the asterisked materials have corrosive effects.

TABLE A

$C_{12}H_{22}O_{11}$ (sugar)
*NaCl
*KCl
KNO_3
$NaNO_3$
$C_4H_6O_5$ (tartaric acid)

TABLE B

*$CaCl_2$
*LiCl
*$ZnCl_2$
$CaBr_2$
Glycerine

TABLE C

Na_3PO_4

TABLE D

$Na_2Cr_2O_7$
Zn (metallic)
Mg (metallic)

Referring now more specifically to the drawing, Fig. 1 shows a dehydrator tank 10 having a fill vent 11 with a suitable cover for replenishing pellets 16. The liquid level of water removed from air is shown at 14. This water may be drained off through a cock 24 at suitable intervals. A partition 30 divides the tank 10 into a sump 17 and the upper portion receiving the pellets 16. The partition 30 terminates in one side in a porous portion 15 made of coarse screen mesh. The pellets 16 rest on top of the partition 30.

An inlet opening 18 in the dehydrator 12 allows the air to pass into the dehydrator 12. The dehydrator 12 could be used in an air line by connecting an air inlet to the inlet opening 18 and an outlet line to the vent 20 which will allow air to flow into the tank 10 through the opening 18 and up through the pellets 16 to an opening 20 in generally uniform pattern. The opening 20 may be connected to an air hose.

The partition 30 is formed in the shape of the frustum of a cone having the outer periphery of the base thereof attached to the inner periphery of the tank 10. The openings of the partition 30 will be preferably in the order of one-quarter of an inch across and the wire of the screened partition 30 will be made of approximately one-eight inch diameter wire. The chemical material, that is, the salt, will be granular and as it comes to rest in the dehydrator 12, it will take a natural shape such as that shown in Fig. 1 which is, roughly, that of a cone. Since the larger grains of salt will tend to accumulate around the periphery of the base of the cone, the air from the inlet opening 18 will pass through the cone generally uniformly over the area thereof. That is, a portion of the air will pass up through the center as indicated by the arrows and the remainder of the air will pass through around the edges adjacent the base.

In the embodiment of the invention shown in Fig. 2, a dehydrator 112 having a tank 110 is shown with an inlet 132 and an outlet 120. The inlet 132 is curved so that the air will take a downward swirling action and, therefore, throw out any entrained water. A baffle 130 is a solid baffle having the outer periphery thereof attached to the inside of the tank 110 at 121. A baffle 115 is a solid baffle having a solid center portion and being attached to the outer periphery of the tank 110 at spaced points so that air can pass around the baffle 115 as indicated by the arrows. A baffle 118 is similar to the baffle 130.

Therefore, when material 116 falls through an opening 111 and settles on top of the baffle 118, it will take the shape of a cone as shown and a part thereof will fall through the central opening of the baffle 118 and rest on top of the central part of the baffle 115 as shown. Then, since the coarser grains of the material 116 seek their natural level adjacent the outer peripheral edges of the baffle 118, the air will pass through the material 116 generally uniformly as indicated by the arrows and since the salt material is hygroscopic, it will absorb the moisture from the air and the absorbed moisture will go into solution and flow down and accumulate in a sump 117 at 114. A suitable drain 124 can be provided to drain

the sump 117 occasionally.

WHAT WE CLAIM IS:—

1. A dissolvable granular porous pellet comprising a major portion of a low hygroscopicity soluble substance as the integral porous core portion thereof, and a minor portion of a soluble higher hygroscopicity substance impregnated on at least the surface portions of said porous core portion.

2. The dissolvable porous pellet recited in claim 1 wherein said low hygroscopicity substance consists of one of the substances shown in Table A of the specification and wherein said higher hygroscopicity substance consists of one of the substances shown in Table B of the specification hereof.

3. The pellet recited in claim 1 wherein said pellet is from one-sixty-fourth inch to one inch in maximum dimension.

4. The dissolvable granular pellet recited in claim 1 wherein said low hygroscopicity substance comprises from ninety to ninety seven per-cent by weight, and said higher hygroscopicity substance comprises from three to ten per-cent by weight of said pellet.

5. The porous pellet recited in claim 1 wherein said low hygroscopicity substance is sodium chloride and said higher hygroscopicity substance is calcium chloride.

6. The porous pellet recited in claim 1 or 5 wherein said higher hygroscopicity substance contains a minor quantity of a material having a rust inhibiting property.

7. A method of manufacturing a dissolvable integral granular desiccant porous pellet consisting of a porous core portion of a low hygroscopicity soluble substance and a minor portion of a higher hygroscopicity substance by impregnating said porous core portion with a solution of said higher hygroscopicity substance.

8. The method of manufacturing a dissolvable granular desiccant pellet recited in claim 7 wherein said core portion of soluble substance is first heated to a temperature below its melting point prior to being saturated with said higher hygroscopicity substance.

9. A method of dehumidifying gas that contains moisture comprising depositing a material in the path of flow of said gas so that said gas passes through said material, said material comprising integral pellets of ninety to ninety-seven per-cent sodium chloride impregnated with three to ten per-cent calcium chloride whereby said moisture from said gas goes into solution with said calcium chloride and sodium chloride, and providing a sump below said material to accumulate a solution of said sodium chloride, calcium chloride, and said moisture.

10. A dehumidifier comprising an inlet and an outlet, and means to support a material on the inside of said dehumidifier between said inlet and said outlet whereby a gas passing from said inlet to said outlet will pass through said material, said material consisting of particles of sodium chloride, each of said particles being made up of a porous pellet impregnated with calcium chloride, said sodium chloride being present in an amount from ninety to ninety-seven per-cent by weight and said calcium chloride being present in an amount from three to ten per-cent by weight of the total particle weight.

11. A dehydrator material substantially as described with reference to the examples.

12. A method of manufacturing a dissolvable porous pellet substantially as described.

13. A method of dehumidifying gas substantially as described.

14. A dehumidifier apparatus substantially as described and illustrated in the accompanying drawings.

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1,014,594 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

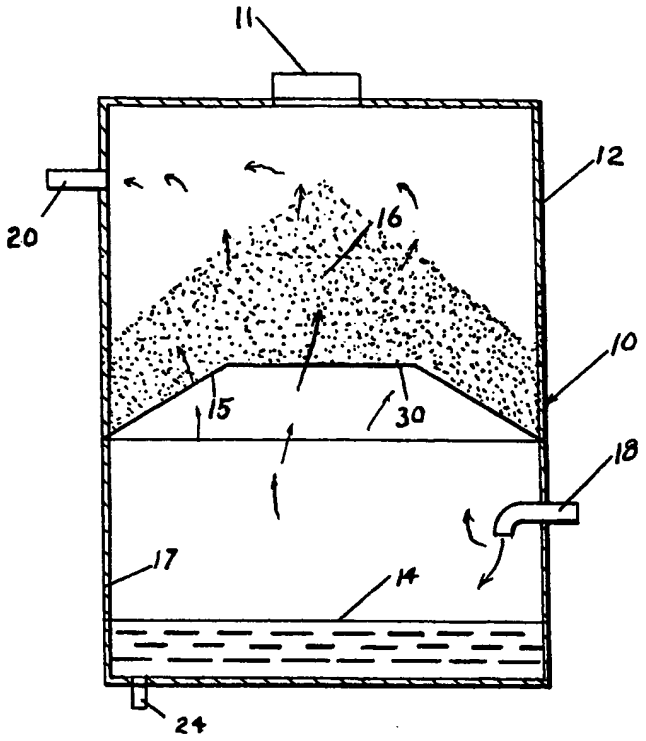

Fig.1

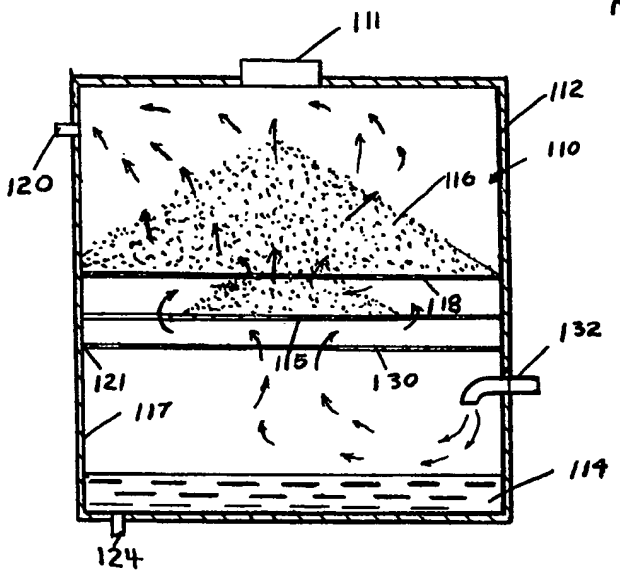

Fig 2